

## DESCRIPTION

**RADIO COMMUNICATION SYSTEM**

5       The present invention relates to a radio communication system comprising a plurality of stations which may communicate with one another. Although the present invention is described with particular reference to a HIPERLAN/2 system, it is applicable to a wide range of other communication systems in which peer-to-peer communications are possible.

10       One example of such a communication system is HIPERLAN/2 (High Performance Radio Local Area Network type 2), currently being standardised by the European Telecommunications Standards Institute (ETSI). Such a system uses radio waves instead of a cable as the transmission medium for  
15       connecting stations. One mode of operation of HIPERLAN/2 permits peer-to-peer networking in which two stations can exchange data directly, instead of via an uplink transmission from the first station to a primary station and a downlink transmission from the primary station to the second station.

20       In a HIPERLAN/2 system, one of the stations assumes the role of a central controller which allocates transmission time slots to stations requiring them and broadcasts information about this time slot allocation information. Hence, each station in a peer-to-peer network knows the time slots in which it may transmit and the respective station to which it may transmit in each of these time slots. Similarly, each station knows the time slots in which it is to  
25       receive and the respective station from which it is to receive in each of these time slots.

30       HIPERLAN/2 transmissions use a conventional Orthogonal Frequency Division Multiplexing (OFDM) scheme with 48 (out of 64) sub-carriers used for data transmission and 4 sub-carriers for pilot signals. A variety of modulation schemes are possible, enabling data rates of between 6 and 54 Mbit/s (with BPSK and 64QAM modulation respectively).

Data is transmitted between stations in short bursts comprising a preamble of length  $16\mu\text{s}$ , subdivided into three sections, and one or more data blocks. During the preamble the receiving station's circuitry has to lock on to the received signal. The first section of the preamble comprises five specific  
5 OFDM symbols transmitted on every fourth sub-carrier, having a total duration of  $4\mu\text{s}$ . This section enables the receiving station to determine appropriate Automatic Gain Control (AGC) settings.

The second section of the preamble comprises another five specific OFDM symbols, again transmitted on every fourth carrier and having a total  
10 duration of  $4\mu\text{s}$ . This section enables the receiving station to determine the frequency offset between it and the transmitting station. The first four symbols are identical, enabling the frequency offset to be determined by observation of any rotation of the phase of the received signal — with no frequency offset the phase should remain constant.

15 The very short time periods provided in the preamble for determining the AGC setting and frequency offset place considerable demands on the receiver circuitry.

An object of the present invention is to reduce these demands placed  
20 on the receiver circuitry.

According to a first aspect of the present invention there is provided a radio communication system comprising a controller and a plurality of stations, each station comprising transmission and reception circuitry, in which peer-to-peer communication between stations takes place in time slots allocated by  
25 the controller, wherein a receiving station has means for storing information relating to a transmission parameter of each of the others of the plurality of stations and means for adjusting its receiver circuitry prior to reception of a signal from a transmitting station depending on the stored information relating to the transmission parameter of the transmitting station.

30 According to a second aspect of the present invention there is provided a station for use in a radio communication system comprising a controller and a plurality of stations, each station comprising transmission and reception

circuitry, in which peer-to-peer communication between stations takes place in time slots allocated by the controller, wherein the station has means for storing information relating to a transmission parameter of each of the others of the plurality of stations and means for adjusting its receiver circuitry prior to reception of a signal from a transmitting station depending on the stored information relating to the transmission parameter of the transmitting station.

According to a third aspect of the present invention there is provided a method of operating a radio communication system comprising a controller and a plurality of stations, each station comprising transmission and reception circuitry, in which peer-to-peer communication between stations takes place in time slots allocated by the controller, wherein a receiving station stores information relating to a transmission parameter of each of the others of the plurality of stations and adjusts its receiver circuitry prior to reception of a signal from a transmitting station depending on the stored information relating to the transmission parameter of the transmitting station.

The present invention is based upon the recognition, not present in the prior art, that storage of parameters such as frequency offset and received power level for a plurality of stations in a peer-to-peer network considerably reduces the demands placed on the receiver circuitry in a station.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a block schematic diagram of a radio communication system; and

Figure 2 is a flow chart illustrating a method in accordance with the present invention for operating a station.

Referring to Figure 1, a peer-to-peer radio communication system comprises a plurality of stations 100a, 100b, 100c. The stations in this example are all identical, although one of them will have assumed the role of controller. This selection may be done in several ways, for example either by negotiation between the stations or by the first station to be activated taking the role of

controller. Each station 100a,100b,100c comprises a microcontroller ( $\mu$ C) 102 and transceiver means (Tx/Rx) 104 connected to antenna means 106. Communication between stations 100a,100b,100c takes place on a radio channels 110.

5        A typical example of such a system is an in-home network, which may for example include stations 100a,100b,100c in a television, a video recorder, a hi-fi system and a computer. Alternatively, one or more of the stations 100a,100b,100c may be stand-alone.

10        In a system made in accordance with the present invention, the microcontroller 102 in each station 100a (or 100b or 100c) stores information about signals received from the other stations 100b,100c (or 100a,100c or 100a,100b), participating in the local network. In its simplest form this information could simply be the signal strength and/or the frequency offset of the last received signal from a particular station, for example station 100b or  
15        100c in the case of the station 100a storing the information. By making use of this information, when a first station 100a is scheduled by the central controller to receive a transmission from a second station 100b it uses the stored information to make an initial adjustment of the frequency offset and gain of its receiver circuitry. Since these parameters will typically change quite slowly, the  
20        adjustments made by the receiver circuitry of the first station 100a during reception of the preamble are significantly reduced by this initial adjustment. Hence the demands on the receiver circuitry are also significantly reduced and the probability that the receiver is correctly adjusted to receive data blocks from the second station 100b is increased.

25        Other parameters relating to signals received from stations 100b,100c could also be stored. For example, if the first station 100a has an electronically steerable antenna 106 it could also store information on the direction of a second station 100b. This would enable the antenna 106 to be adjusted for optimum reception of signals from the second station 100b, improving the  
30        signal to noise ratio of the received signal. The skilled person will readily appreciate that various other parameters could usefully be stored depending on the type of system and the standard according to which it operates.

09740 00010  
F0700 0700

An improvement to the system disclosed above results if each station 100a stores information relating to a number of previous transmissions by each of the other stations 100b, 100c together with the time at which they were received. In this way the history of the behaviour of the signals from a particular station 100b is available, enabling a more accurate initial adjustment of the receiver circuitry of the first station 100a. For example, from measurements of the frequency offset of the second station 100b and knowledge of the present time enable the first station 100a to predict more accurately the expected frequency offset at the start of a transmission. The simplest example of this would be to determine a first order correction to the frequency offset from the time since the last transmission from the second station 100b together with the rate of drift of its frequency offset.

A method of operating the first station 100a in accordance with the present invention is illustrated in the flow chart of Figure 2. The method begins, at step 202, when the first station 100a determines that it is due to receive a transmission from the second station 100b. The first station 100a then determines, at step 204, suitable values for its receiver circuitry as described above. These values are then used, at step 206, to make an initial adjustment of the receiver circuitry. When this has been done, the first station 100a receives a preamble from the second station 100b, during which the receiver parameters are further adjusted. Finally, at step 210, the newly-determined receiver parameters are stored for later use and the data blocks are received from the second station 100b.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and use of radio communication systems and component parts thereof, and which may be used instead of or in addition to features already described herein. Although claims have been formulated in this application to particular combinations of features, it should be understood that the scope of the disclosure of the present application also includes any novel feature or any novel combination of features disclosed herein either explicitly or implicitly or any generalisation

thereof, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same technical problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or combinations of features during the prosecution of the present application or of any further application derived therefrom.

In the present specification and claims the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, the word "comprising" does not exclude the presence of other elements or steps than those listed.

09773418 "000101  
PHGB 000010 US